DDF annual report

**Title of Investigation:**

Student Balloon Science and Engineering Flight Payloads

**Principal Investigator:**

Joel Simpson (Code 598)

**Other In-house Members of Team:**

Debora Fairbrother (Code 820), Charles Brodell (Code 870), Jessica Thompson (Code 598)

**Other External Collaborators:**

Dr. Gail Welsh (Salisbury University) and Dr. Joseph Howard (Salisbury University)

**Initiation Year:**

FY 2005

**Aggregate Amount of Funding Authorized in FY 2004 and Earlier Years:**

$0

**Funding Authorized for FY 2005:**

$15,000

**Actual or Expected Expenditure of FY 2005 Funding:**

Grants: Salisbury University, $7,000, and the University of Maryland Eastern Shore, $5,000; Equipment: Onset Computer Corp., $2,500, and miscellaneous electronics, $500

**Status of Investigation at End of FY 2005:**

To be continued in FY 2006 with funds remaining from FY 2005 and an additional $15,000 in FY 2006 DDF funding

**Expected Completion Date:**

FY 2006

**Purpose of Investigation:**

The goals of this investigation are to involve the local community in NASA missions and attract future scientists and engineers into NASA's suborbital science programs. The first goal is to involve the local community by inviting students and teachers to take part in a real NASA mission. University physics students will be exposed to the technical challenges of conceiving, designing, and implementing a stand-alone experiment. Students will attempt to make and interpret scientific measurements of their own design and explore the characteristics and unique flight regime of lighter-than-air vehicles. In addition, middle school teachers associated with the university can contribute to the project by challenging their students to develop their own experiments. Fundamental science and engineering concepts will be integrated into middle school curricula to teach students topics relevant to balloon flight.

The second purpose of this investigation is to inspire future scientists and engineers through real world experience. Students are involved in every aspect of engineering, from concept through post-flight, giving them a sense of ownership and responsibility in NASA's missions. This project has a significant impact on the students because it provides a hands-on application to concepts learned in the classroom. Another benefit of the project will be the collection and analysis of real data for the university physics students. The hope is that this process will educate students on the importance of understanding and applying science and engineering concepts to further our quest for discovery.

**Accomplishments to Date:**

All of the minimum and comprehensive success criteria for this project were met in FY 2005. By working with academic advisors and NASA engineers, three university physics/engineering student teams designed, built, and environmentally tested their packages. In addition, through a university physics course for middle school science teachers, 180 middle school students developed their own experiments. NASA engineers kicked off the program by participating in interactive sessions at each school.

**Figure 1.** Wallops Flight Facility engineers discuss ballooning with local middle school students

**Figure 2.** University students worked well with NASA engineers.

**Figure 3.** The team is still smiling following a design review.

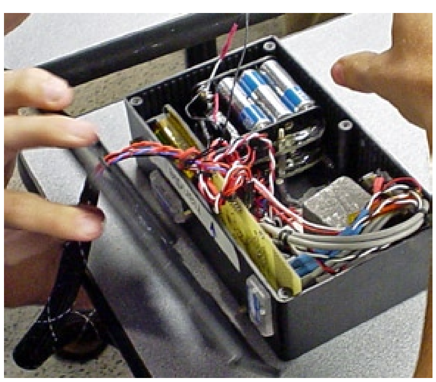

**Figure 4.** A sample engineering experiment

Once the experiments were readied for flight, university team representatives completed the integration process at the Wallops Flight Facility (WFF). The student experiments consist of a variety of scientific measurements, including barometric pressure, pressure- related acoustic variances, temperature, solar radiation, acceleration, gravitational and magnetic field changes. Each of the three teams autonomously collected their data using a data logger. Middle school students were able to contribute two packages, each containing several passive experiments. All student packages were flown piggyback on a scientific balloon flight, which was launched from the National Scientific Balloon Facility (NSBF) in New Mexico in September 2005. The packages were returned in October 2005 and students are currently conducting post-flight analysis of their science and engineering data.

**Figure 5.** A physics student loads her experiment into the environmental chamber at Wallops.

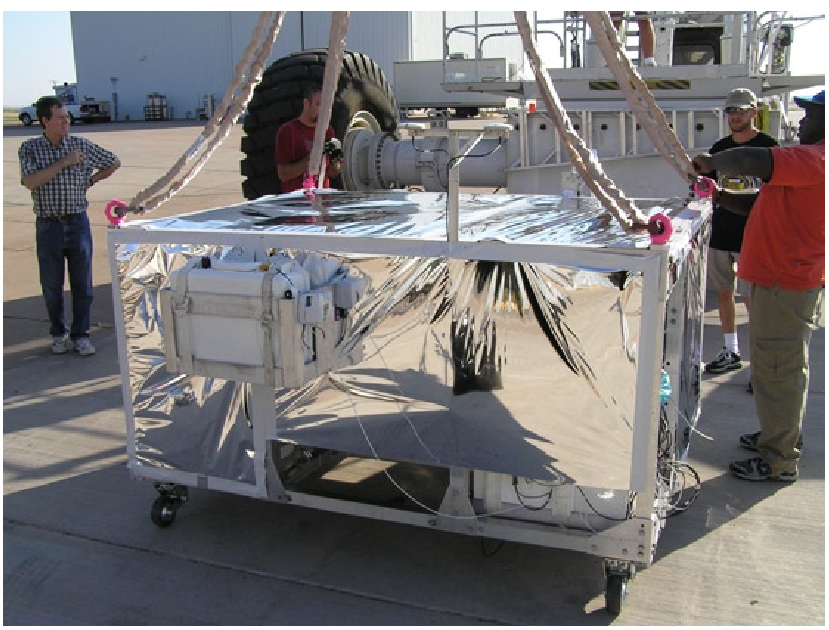

**Figure 6.** NSBF engineers secure the suitcase-sized experiment to the payload.

**Figure 7.** Long Duration Balloon (LDB) launch

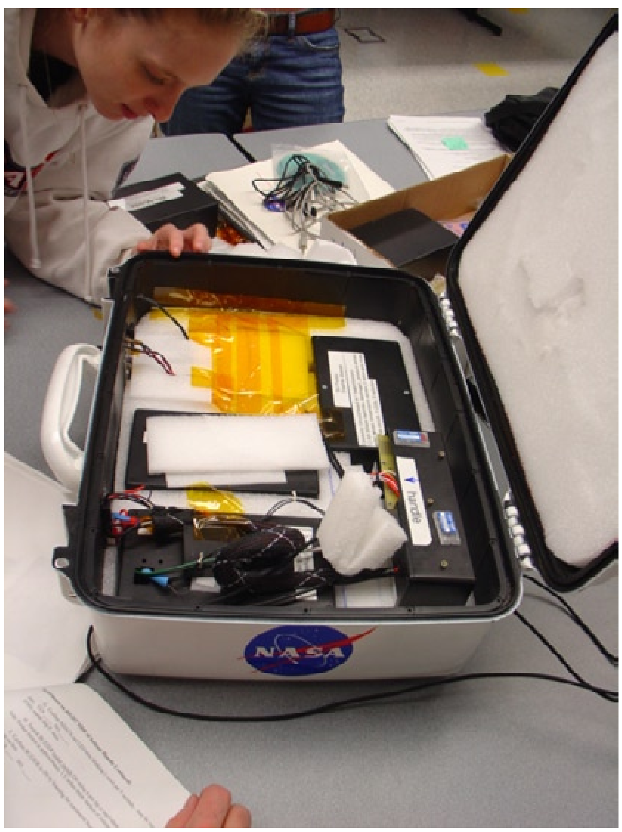


**Figure 8.** The suitcase is successfully returned.

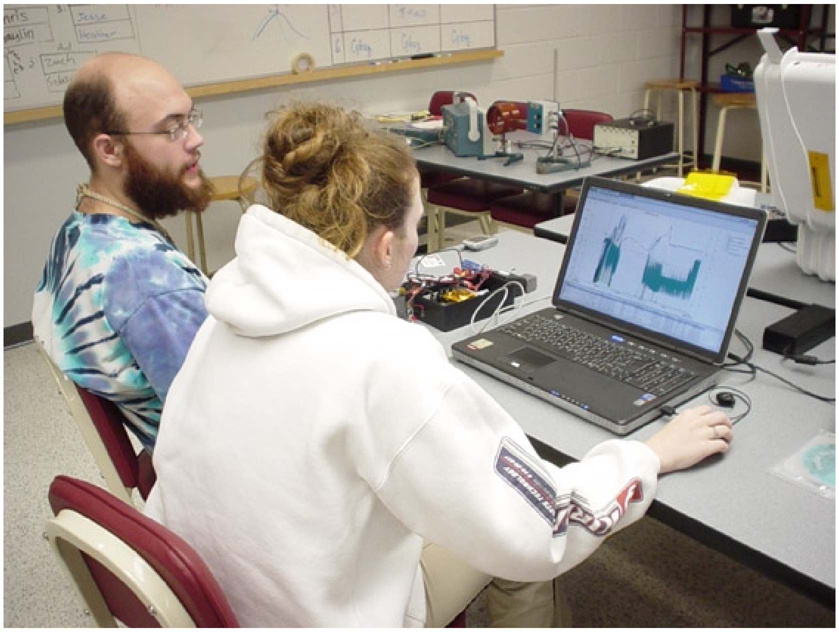

**Figure 9.** Students begin post-flight analysis of their atmospheric data.

**Planned Future Work:**

The extension focused on maturing simple payload designs for NASA balloon flight opportunities for two universities and several associated local middle schools. It also will allow teachers to incorporate experiment design and post-flight analysis (from FY 2005 DDF) into their fall lesson plans.

Future work also will include locating sources for sustainability. Commitments for continued flight opportunities have been made by Code 820/Balloon Programs Office (BPO). Continued technical support likely will be available through Applied Engineering and Technology Directorate (AETD) engineers. Other considerations for support include the National Oceanic and Atmospheric Administration (NOAA), the National Science Association, and local businesses (for procuring hardware).

**Key Points Summary:**

**Project's innovative features:** Scientific balloon flight opportunities are made available at a very low cost to NASA, while providing a unique engineering connection to exploration and system autonomy for students. Students are involved in developing experiments, from concept to post-flight.

**Potential payoff to Goddard/NASA:** This process will enhance NASA's relationships with the local education community and entice future scientists and engineers through real world hands-on experience.

**The criteria for success:** The minimum success criteria for this project include participation of students and teachers and completing the stages leading up to a balloon launch (design, design review, development, test, verification in the environmental chamber, and integration). The comprehensive success criteria include participating in a webcasting of the launch, de-integration, post-flight analysis, and conducting a debriefing.

**Technical risk factors:** These include funding issues, school involvement, and student participation. Availability of balloon flights is an additional risk, but this does not impact minimum success criteria.